



# UNIVERSITY OF MINES AND TECHNOLOGY, TARKWA

FIRST SEMESTER EXAMINATIONS, NOV/DEC. 2018

**COURSE NO:** GL/MN/PE/ES 455  
**COURSE NAME:** Geographic Information System  
**CLASS:** GL/MN/PE/ES IV **TIME:** 3 HOURS

Name: \_\_\_\_\_ Index Number: \_\_\_\_\_

## ATTEMPT ONLY 2 QUESTIONS

### Question One

In September 2018, after opening the spill gates of the Bagre Dam in Southern Burkina Faso, many places in the northern part of Ghana flooded as the white and Black Volta Rivers overtopped their banks. Use the following information to answer questions about the floods.

#### Vector data provided

*River line map, roads line map, schools polygon, homes polygons, hospitals polygons, maize farm polygons, millet farm polygons, rice farm polygons.*

#### Questions to answer

- (a) If the river has been flooded and a 30 m buffer around it defined the flooded area, describe how you will use GIS analysis to determine the number of Homes, Schools and Hospitals flooded. **[5 marks]**
- (a) If the National Government is to pay compensation to the local Government based on the area flooded and the rate is 2000 Ghana cedis per square kilometre of flooded land, describe how you will determine the total compensation due to the local government, using GIS spatial analysis. **[5 marks]**
- (b) If the local government has decided to pay compensation to persons whose farms have been flooded and has determined that the compensation per farm type is as follows: maize farm: **5000 Ghana cedis per Hectare**, Millet farm: **6000 Ghana cedis per Hectare** and Rice farm: **7000 Ghana cedis per Hectare**. Describe how you will use GIS/spatial analysis to determine the compensation due each farmer as well as the total compensation to be paid by the local government. **[5 marks]**
- (c) If it cost 100000 Ghana cedis per 1 kilometre to repair a flooded road, describe how you will use GIS and the data above to determine the total cost of roads to repair after the floods. **[5 marks]**

### Question Two

- [a] Describe the concept of data models in GIS. **[2 marks ]**
- [b] Describe buffer operations and state three (3) of their applications. **[ 4 marks ]**
- [c] Describe the relationship between raster resolution and size of raster data on a disk?  
**[3 marks]**
- [d] List the components of a GIS and describe them. **[ 5 marks ]**
- [e] State three (3) reasons for interpolation of data and briefly discuss three of the techniques used in GIS.  
**[ 4 marks ]**

[f] Describe the two sources of data for a GIS system.

[ 2 marks ]

**Question Three**

[a] List three tasks a GIS can perform.

[ 1.5 marks ]

[b] State the basic types of projections used in GIS and list the characteristics of one of the systems

[4 marks ]

[c] Briefly describe how to calculate length and areas of vector and raster data, respectively. You may include any formulae.

[ 3 marks ]

[d] State the basic difference between the following terms

- i. The hybrid and integrated GIS database systems. [ 1 mark ]
- ii. Primary and foreign keys in a database. [ 1 mark ]
- iii. The first and second normal forms. [ 1 mark ]
- iv. Many-to-many and one-to-many attribute table relationships. [ 1 mark ]
- v. Attribute and spatial data queries. [ 1 mark ]

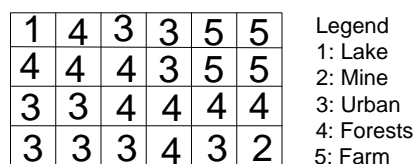
[e] Complete Table 1 by indicating the resultant layer type after intersection of two input layers of the type listed. [ 2.5 marks ]

Table 1

Input layer 1 type	Input layer 2 type	Output layer type
point	line	
point	polygon	
line	line	
line	polygon	
polygon	polygon	

[f] Use the raster data in Figure 1, with a ground resolution of 20 m to answer the following questions:

- i. Calculate the area covered by the forests, urban and farms. [ 1.5 marks ]
- ii. Determine the distance between the mine and the Lake. [2 marks ]
- iii. Simplify the raster data by reclassifying it into forests other land uses. [ 0.5 mark ]



**Figure 1: Raster map**

#### **Question Four**

[A] Distinguish between raster data model and vector data model. [10 marks]

[B] Your company has been provided with an excel data with X-Y Coordinates and Lead values in ppm to develop a spatial distribution map of Lead Concentrations. The file of the excel data is named as “obs” with id, X-coordinate, Y-Coordinate and Lead. You are to prepare a step by step approach

(Cookbook) for your subordinate to do the following: [20 marks]

- (i) Display the XY data and export the point map as “lead” layer
- (ii) Log transform lead using normal QQplot and add it to your layer.
- (iii) Use the geostatistical analyst wizard to map the spatial distribution of lead concentration using ordinary kriging.
- (iv) Your north arrow should be 45° from the true north.
- (v) Clip the layout to the extent of the point map.
- (vi) Apply the various cartographic visualisation

#### **Question 5**

[A] Define cartographic visualization process and state three factors that influence the process [12 marks]

[B] You are to create a population density map of Ghana for 2020 using the *Regions Layer, equations 1 & 2* as well as *Table 2*. You are to prepare a step by step approach (Cookbook) to do the following:

[28 marks]

- (i) Open the attribute table of Regions and delete all the fields except FID, Shape\*, NAME and CAPITALS.
- (ii) Add the following fields: Pop10; Pop20; Area and Popdensity.
- (iii) Your map should have the colour ramp: Yellow to Dark Red
- (iv) the legend should be at the top right corner of your map and label all the regions.
- (v) You are to save your map as Population Density 2020 and export your layout as JPEG with your index number.

Table 2: Population Data

Name	Area	Pop2010
Upper East	8842	1046545
Upper West	18476	702110
Northern	70384	2479461
Volta	20570	2118252
Brong Ahafo	39557	2310983
Ashanti	24389	4780380
Eastern	19323	2633154
Western	23921	2376021
Central	9826	2201863
Greater Accra	3245	4010054

(Source: GSS, 2010)

$$Pop_{20} = Pop_{10} (1 + r)^n \quad \dots \quad Eqn 1$$

$$\text{Popdensity} = \text{Pop20}/\text{Area} \quad \dots$$

*Eqn 2*

Where  $r = 2.5\%$ ;  $n = 10$  yrs

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